Referee Report to the Joint session of the PACs for PP & NP for the assessment of the JINR Neutrino Projects on the Project

"Project DANSS: Detector of the reactor antineutrino based on solid state plastic scintillators"

This project concerns with the construction of a new and original concept of a detector for reactor anti-neutrino based on solid state plastic scintillators. The purpose is mainly two-fold: to operate as a monitor of power plants by the measurement of energy spectra of reactor antineutrinos and to check the claim of the existence of sterile neutrino. The spectrometer is mounted at the fourth power unit of the Kalinin NPP under the WWER1000 reactor. The detector, designed and built at JINR, is based on a highly segmented array (2500 independent detecting cells) of polystyrene-based plastic scintillator bars readout by optical fibers connected to photodetectors. Antineutrinos are detected by the inverse beta decay. Because of the radiation hardness and of the principle of operation, DANSS detector can operate at an unprecedent distance of 10-12 m from the reactor core. The detector is placed on a mobile pedestal which allows the variation of the distance from the nuclear core to record and compare data at different position.

From the data recorded from 2016 till 2020, DANSS detector has demonstrated great stability in the long-term monitoring of reactor power and sensitivity to nuclear fuel composition. It has collected a remarkable event rate of about 5000 antineutrinos per day. More outstandingly, it has collected antineutrino spectra, at different distances from the core that do not show a significant signal of oscillations to the sterile neutrino, and consequently excluding the hypothesis of a sterile neutrino for a large part of the expected region in the plot Δm^2_{14} vs $\sin^2\theta_{14}$.

Based on the experience gained and the excellent performance of the DANSS project, it is an excellent proposal to push forward the study of the neutrino oscillations to larger masses and to investigate the problem of the reactor spectral anomaly, namely the excess of the measured neutrino flux in the 4-6 MeV region in comparison with the predictions. These new objectives can be met by a new design of a DANSS detector, namely, the project proposed as DANSS-2. The expectation is to improve the energy resolution and to enhance the sensitivity. The new project concerns with the realization of a new detecting cell made of "better" plastic scintillators, with more fibers per cells, for a more efficient light collection, and updated electronics.

DANSS-2 is expected to be completed by the mid of 2022 and should take data till the year 2024. The upgraded project is very well documented, and the work plan seems compatible with the man-power. The topics addressed are of great interest for

fundamental science. The work done so far is very well documented in scientific publications, although mainly conference proceedings. In parallel, the group collaborate with Czech colleagues to develop a new detector S3 to study systematics related to the neutrino flux.

I recommend supporting this project with the highest priority.

January 20, 2021 Emanuele Vardaci